

New Hampshire Volunteer River Assessment Program 2005 Cocheco River Water Quality Report



Photo: Cocheco River (26-CCH), Central Street Bridge, Farmington

Prepared by:

State of New Hampshire
Department of Environmental Services
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January 2006



**New Hampshire Volunteer River Assessment Program
2005 Cocheco River Water Quality Report**

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The New Hampshire Department of Environmental Services (NHDES) -Volunteer River Assessment Program (VRAP) extends sincere thanks to the volunteers of the Cocheco River Advisory Group for their efforts during 2005. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

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1. INTRODUCTION

1.1. Purpose of Report

Each year the VRAP prepares and distributes a water quality report for each volunteer group that is based solely on the water quality data collected by that volunteer group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups.

1.2. Report Format

Each report includes the following:

❖ Volunteer River Assessment Program (VRAP) Overview

This section includes a discussion of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

❖ Monitoring Program Description

This section provides a description of the volunteer group's monitoring program including monitoring objectives as well as a table and map showing sample station locations.

❖ Results and Discussion

Water quality data collected during the year are summarized on a parameter-by-parameter basis using (1) a summary table that includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station, (2) a discussion of the data, (3) a list of applicable recommendations, and (4) a river graph showing the range of measured values at each station. Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

❖ **Appendix A – Data**

This appendix includes a spreadsheet showing the data results and additional information, such data results which do not meet New Hampshire surface water quality standards, and data that is unusable for assessment purposes due to quality control requirements.

❖ **Appendix B – Interpreting VRAP Water Quality Parameters**

This appendix includes a brief description of water quality parameters typically sampled by VRAP volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

❖ **Appendix C – Glossary of River Ecology Terms**

This appendix contains a list of terms commonly used when discussing river ecology and water quality.

2. PROGRAM OVERVIEW

2.1. Past, Present, and Future

In 1998, the New Hampshire Department of Environmental Services (NHDES) initiated the New Hampshire Volunteer River Assessment Program (VRAP) as a means of expanding public education of water resources in New Hampshire. VRAP promotes awareness and education of the importance of maintaining water quality in rivers and streams. VRAP was created in the wake of the success of the existing New Hampshire Volunteer Lake Assessment Program (VLAP), which provides educational and stewardship opportunities pertaining to lakes and ponds to New Hampshire's residents.

Today, VRAP continues to serve the public by providing water quality monitoring equipment, technical support, and educational programs. In 2005, VRAP supported twenty-eight volunteer groups on numerous rivers and watersheds throughout the state. These volunteer groups conduct water quality monitoring on an ongoing basis. The work of the VRAP volunteers increases the amount of river water quality information available to local, state and federal governments, which allows for effective financial resource allocation and watershed planning.

2.2. Technical Support

VRAP lends and maintains water quality monitoring kits for volunteer groups throughout the state. The kits contain electronic meters and supplies for "in-the-field" measurements of water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. These are the core parameters typically measured by volunteers. However, other water quality parameters such as nutrients, metals, and *E. coli* can also be studied by volunteer groups, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages volunteer groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

VRAP typically recommends sampling every other week during the summer, and volunteer groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers design and arrange a sampling schedule in cooperation with NHDES staff. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a

river is meeting surface water quality standards. Volunteer monitoring results, meeting DES Quality Assurance and Quality Control (QA/QC) requirements, supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

2.3. Training and Guidance

Each VRAP volunteer attends an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to receive an updated version of monitoring techniques. During the training, volunteers have an opportunity for hand-on use of the VRAP equipment and may also receive instruction in the collection of samples for laboratory analysis. Training is accomplished in approximately two hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment. In some cases, veteran group coordinators can attend a “train the trainer” session. In these trainings the group coordinator receives an update in sampling protocols and techniques and will then train the individual volunteers of their respective group.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. NHDES staff from the VRAP program aim to visit each group annually during a scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group’s monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

2.4. Data Usage

2.4.1. Annual Water Quality Reports

All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period (typically fall or winter). Each volunteer group receives copies of the report. The volunteers can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

2.4.2. New Hampshire Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic DES surface water quality assessments. VRAP data are entered into NHDES’s Environmental Monitoring Database and are ultimately uploaded to the Environmental Protection Agency’s database, STORET.

Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the DES web page to review the assessment methodology and list of impaired waters <http://www.des.state.nh.us/wmb/swqa/>.

2.5. Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP Quality Assurance/Quality Control (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- ❖ **Calibration:** Prior to each measurement, the pH and dissolved oxygen meters are calibrated. Conductivity and turbidity meters are calibrated and/or checked against a known standard before the first measurement and after the last one.
- ❖ **Replicate Analysis:** A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. The replicate analysis should not be conducted at the same station over and over again, but should be conducted at different stations throughout the monitoring season.
- ❖ **6.0 pH Standard:** A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.
- ❖ **Zero Oxygen Standard:** A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.
- ❖ **DI Turbidity Blank:** A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.
- ❖ **Post-Calibration:** At the conclusion of each sampling day, all meters are calibrated.

2.5.1. Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \%$$

where x_1 is the original sample and x_2 is the replicate sample

Table 1. Field Analytical Quality Controls

Water Quality Parameter	QC Check	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Measurement replicate	± 0.2 °C	Repeat measurement	Volunteer Monitors	Precision
Dissolved Oxygen	Measurement replicate	± 2% of saturation, or ± 0.2 mg/L	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Known buffer (zero O ₂ solution)	<0.5 mg/L	Recalibrate instrument, repeat measurement	Volunteer Monitors	Relative accuracy
pH	Measurement replicate	± 0.1 std units	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Known buffer (pH = 6.0)	± 0.1 standard units	Recalibrate instrument repeat measurement	Volunteer Monitors	Accuracy
Specific Conductance	Measurement replicate	± 30 µS/cm	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Method blank (Zero air reading)	± 5.0 µS/cm	Recalibrate instrument, repeat measurement	Volunteer Monitors	Accuracy
Turbidity	Measurement replicate	± 0.1 NTU	Recalibrate instrument, repeat measurement	Volunteer Monitors	Precision
	Method blank (DI Water)	± 0.1 NTU	Recalibrate instrument, repeat measurement	Volunteer Monitors	Accuracy

3. METHODS

Volunteers from the Cocheco River Watershed Coalition have been monitoring water quality on the Cocheco River since 1999. The goal of this effort was to provide water quality data from the Cocheco River relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact recreation. The establishment of a long-term monitoring program allows for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, financial assistance, and technical assistance.

During 2005, trained volunteers from the Cocheco River Watershed Coalition monitored water quality at 18 sites along the Cocheco River and its tributaries (Figure 1, Table 2). Stations IDs are designated using a three letter code to identify the waterbody name plus a number indicating the relative position of the station. The higher the station number the more upstream the station is in the watershed. All stations monitored in 2005 are designated as Class B waters.

Water quality monitoring was conducted monthly from June to October. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters provided by NHDES. Samples for *E.coli*, total phosphorous, ammonia, and total kjeldahl nitrogen were taken using sterile and/or preserved bottles and were stored on ice during transport from the field to the lab. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

Table 2. Sampling Stations for the Cocheco River, NHDES VRAP, 2005

Station ID	Waterbody Name	Location	Town/City	Elevation*
26-CCH	Cocheco River	Central Street Bridge	Farmington	300
23-CCH	Cocheco River	Watson Corner Road Bridge	Farmington	300
22U-CCH	Cocheco River	Pike Industries	Farmington	300
22-CCH	Cocheco River	Little Falls Bridge Road	Rochester	300
21-CCH	Cocheco River	Route 202A Bridge	Rochester	200
19-CCH	Cocheco River	Route 125 Bridge	Rochester	200
16-CCH	Cocheco River	Above Rochester WWTF	Rochester	200
12-CCH	Cocheco River	Strafford County Farm	Dover	100
11-CCH	Cocheco River	Watson Road Bridge	Dover	100
10-CCH	Cocheco River	Whittier Street Bridge	Dover	100
07-CCH	Cocheco River	Central Avenue Bridge	Dover	0
04-ELA	Ela River	Spring Street Bridge	Farmington	300
02-MAR	Mad River	Route 11 Bridge	Farmington	400
01-MAR	Mad River	Tappen Street Bridge	Farmington	300
01-DMS	Dames Brook	Route 75 Bridge	Farmington	300
01F-RAT	Rattlesnake River	Behind Auto Shop	Farmington	300
03-AXE	Axe Handle Brook	Chelsey Hill Road Bridge	Rochester	200
03-FHC	Fresh Creek	Old Mill Lane Bridge	Rollinsford	300

*Elevations have been rounded off to 100-foot increments for calibration of dissolved oxygen meter

Figure 1. Cochemo River Watershed and Monitoring Stations 2005

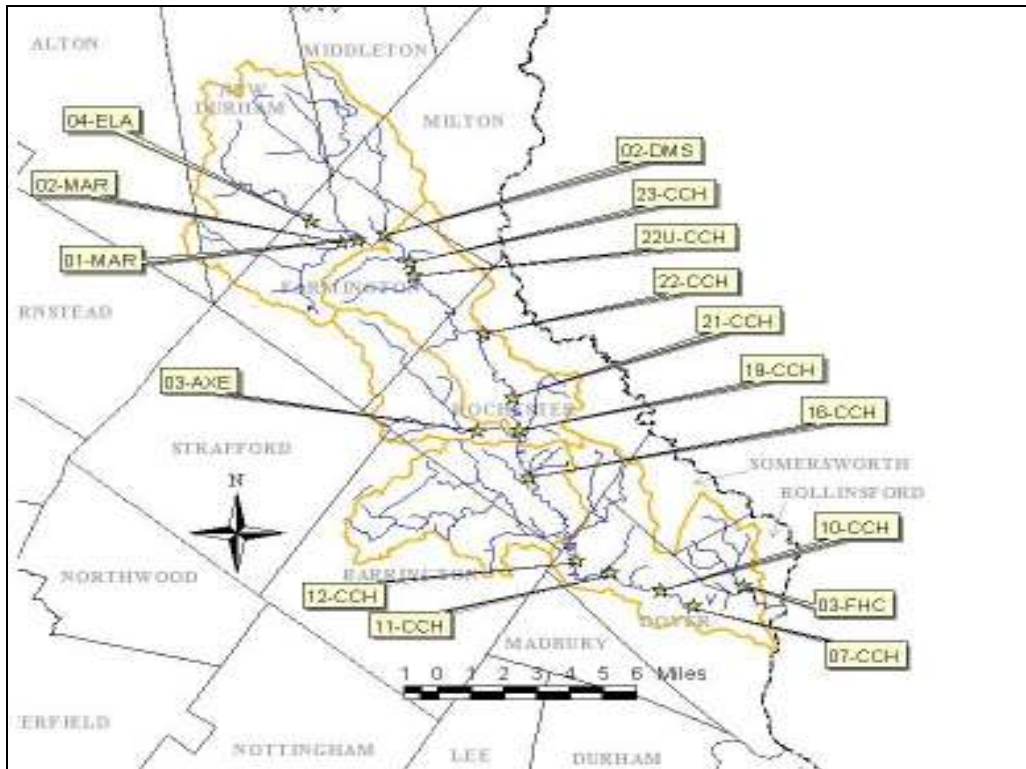


Table 3. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 95	-----
Dissolved Oxygen	In-Situ	SM 4500 O G	YSI 95	-----
pH	In-Situ	SM 4500 H+	Orion 210A+	-----
Turbidity	In-Situ	EPA 180.1	YSI 30	-----
Specific Conductance	In-Situ	SM 2510	Lamotte 2020	-----
E.coli	Bottle (Sterile)	SM 19 9213 D.3	-----	NHDES
	Bottle (Sterile)	EPA 1103.1	-----	Rochester WWTF
Total Phosphorous	Bottle (w/Preservative)	EPA 365.3	-----	NHDES
Total Kjeldahl Nitrogen	Bottle (w/Preservative)	EPA 351.2	-----	NHDES
Ammonia	Bottle (w/Preservative)	EPA 350.1	-----	NHDES

4. RESULTS AND DISCUSSION

4.1. Dissolved Oxygen

Between one and seven measurements were taken in the field for dissolved oxygen concentration at 18 stations on the mainstem and tributaries to the Cocheco River from Farmington to Rollinsford. (Table 4). Of the 68 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

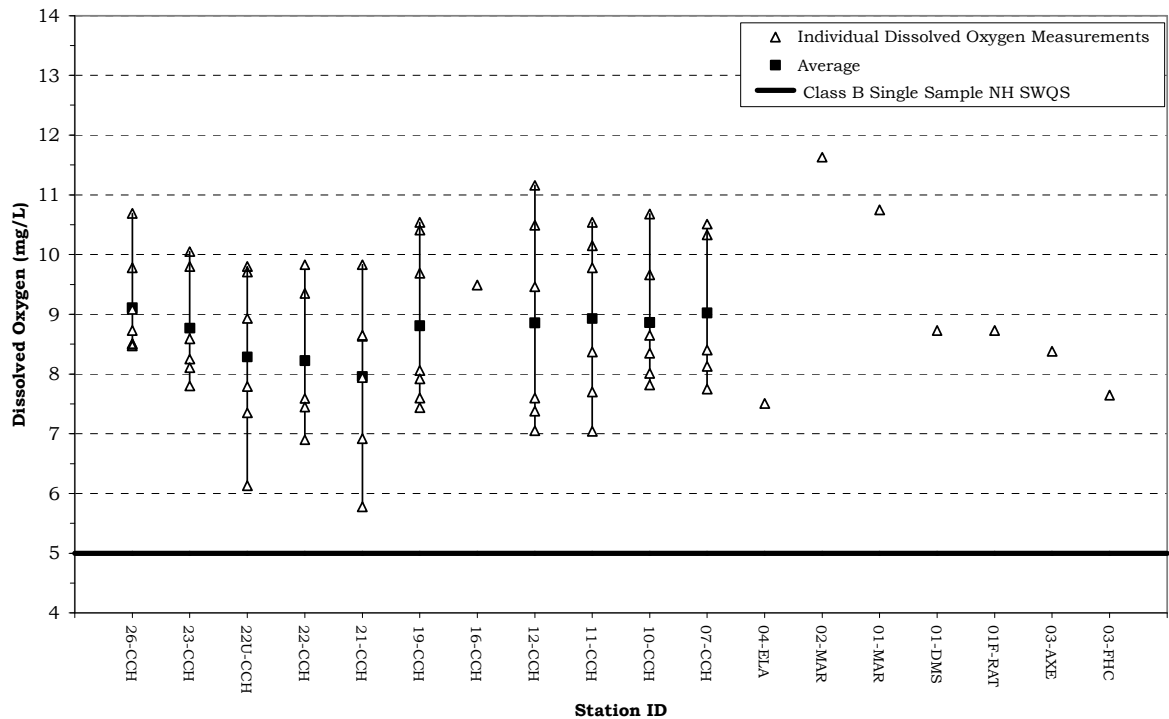
The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards. Table 4 reports only dissolved oxygen concentration as more detailed analysis is required to determine if instantaneous dissolved oxygen saturation measurements are above or below water quality standards.

Table 4. Dissolved Oxygen Concentration Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	7	8.47 - 10.69	0	7
23-CCH	6	7.80 - 10.05	0	6
22U-CCH	6	6.13 - 9.80	0	6
22-CCH	5	6.90 - 9.83	0	5
21-CCH	6	5.78 - 9.83	0	6
19-CCH	7	7.44 - 10.54	0	7
16-CCH	1	9.49	0	1
12-CCH	6	7.05 - 11.16	0	6
11-CCH	6	7.04 - 10.54	0	6
10-CCH	6	7.82 - 10.68	0	6
07-CCH	5	7.75 - 10.51	0	5
04-ELA	1	7.51	0	1
02-MAR	1	11.63	0	1
01-MAR	1	10.75	0	1
01-DMS	1	8.73	0	1
01F-RAT	1	8.73	0	1
03-AXE	1	8.38	0	1
03-FHC	1	7.65	0	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				68

Dissolved oxygen concentration levels were above state standards on all occasions and at all stations (Figure 2). The average concentration of dissolved oxygen was consistently above the Class B standard at all stations ranging from 8.0 mg/L to 9.1 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

**Figure 2. Dissolved Oxygen Statistics for the Cocheco River
June 20 - October 16, 2005, NHDES VRAP**



Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- ❖ If possible, take measurements between 5:00 a.m. and 10:00 a.m., which is when dissolved oxygen is usually the lowest, and between 2:00 p.m. and 7:00 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission.
- ❖ Continue to incorporate the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. The use of these instruments is dependent upon availability, and requires coordination with DES.

4.2. pH

Between one and seven measurements were taken in the field for pH at 18 stations on the mainstem and tributaries of the Cocheco River from Farmington to Rollinsford [Table 5]. Of the 67 measurements taken, 60 met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

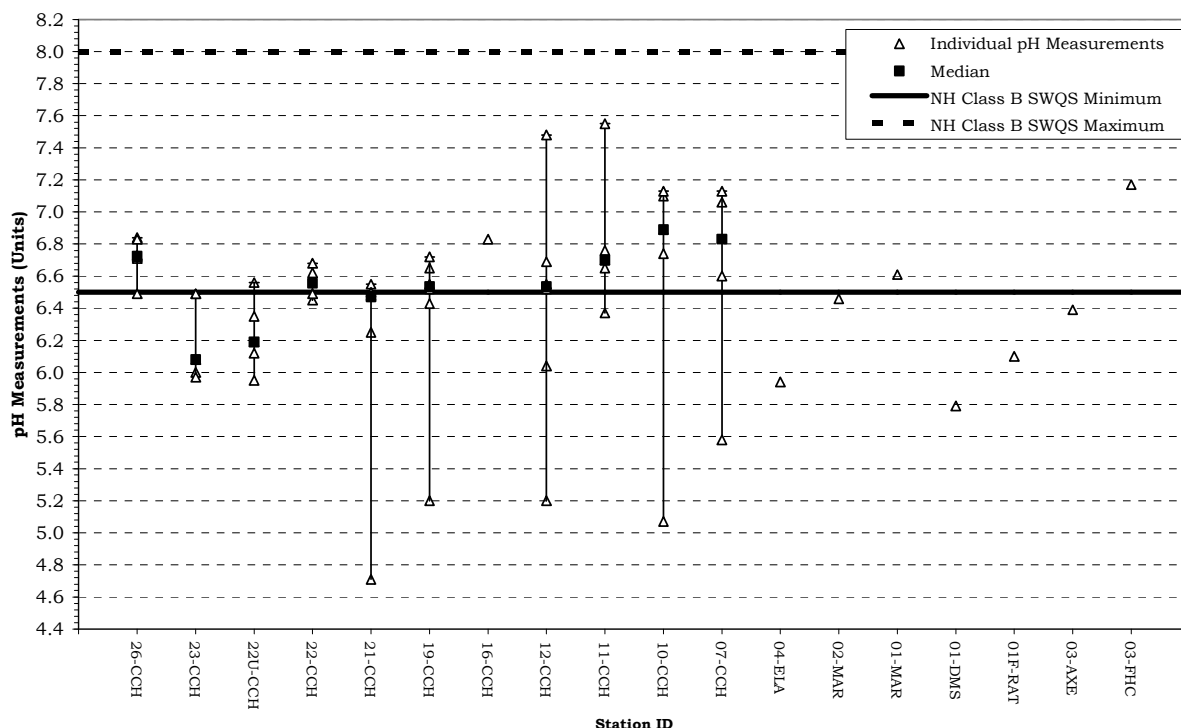
Table 5. pH Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range (standard units)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	7	6.49 - 6.84	6	7
23-CCH	6	5.97 - 6.49	5	6
22U-CCH	6	5.95 - 6.56	4	6
22-CCH	5	6.45 - 6.68	2	5
21-CCH	6	4.71 - 6.55	4	6
19-CCH	6	5.2 - 6.72	2	6
16-CCH	1	6.83	0	1
12-CCH	6	5.20 - 7.48	2	6
11-CCH	6	6.37 - 7.55	1	6
10-CCH	6	5.07 - 7.13	1	5 ^a
07-CCH	5	5.58 - 7.13	1	4 ^a
04-ELA	1	5.94	1	1
02-MAR	1	6.46	1	1
01-MAR	1	6.61	1	1
01-DMS	1	5.79	1	1
01F-RAT	1	6.1	1	1
03-AXE	1	6.39	1	1
03-FHC	1	7.17	1	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				65

^a Unreliable calibration

A majority of pH measurements on the Cocheco River watershed were below the New Hampshire surface water quality standard (Figure 3). Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally have a lower pH.

**Figure 3. pH Statistics for the Cocheco River
June 20 - October 16, 2005, NHDES VRAP**



Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- ❖ Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

4.3. Turbidity

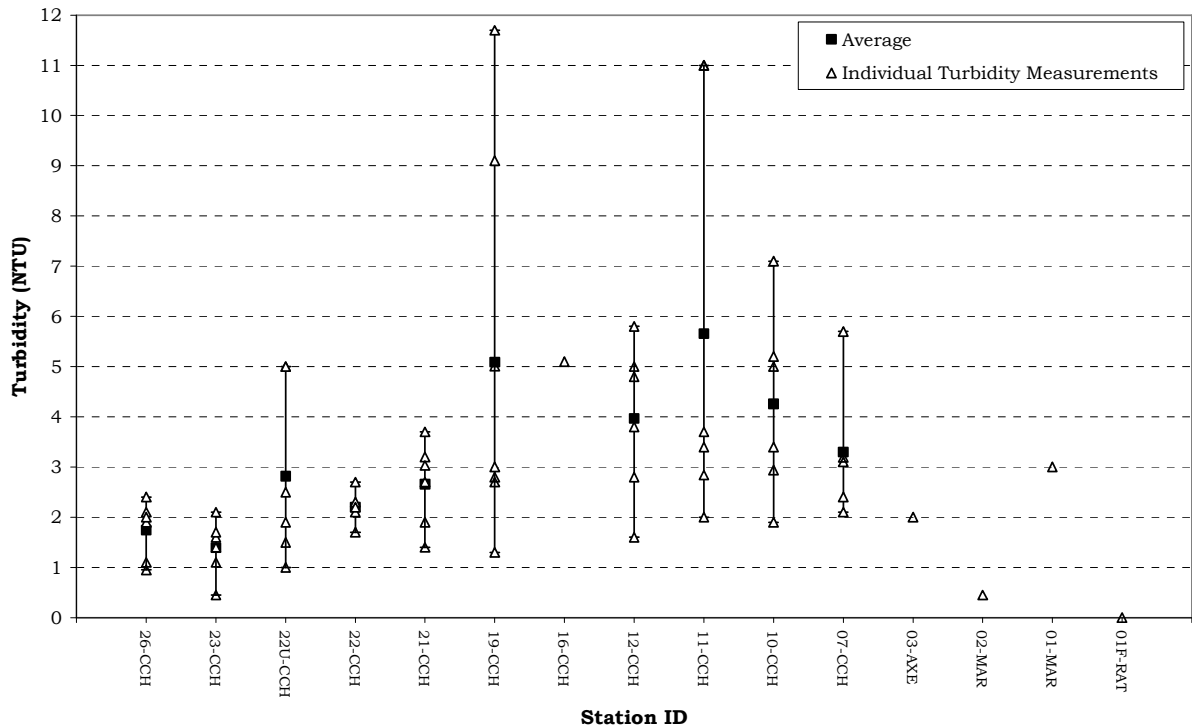
Between one and six measurements were taken in the field for turbidity at 15 stations on the mainstem and tributaries of the Cocheco River from Farmington to Rochester [Table 6]. Of the 63 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above background.

Table 6. Turbidity Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	6	1.0 - 2.4	0	6
23-CCH	6	0.5 - 2.1	0	6
22U-CCH	6	1.0 - 5.0	0	6
22-CCH	5	1.7 - 2.7	0	5
21-CCH	6	1.4 - 3.7	0	6
19-CCH	6	1.3 - 11.7	0	6
16-CCH	1	5.1	0	1
12-CCH	6	1.6 - 5.8	0	6
11-CCH	6	2.0 - 11.0	0	6
10-CCH	6	1.9 - 7.1	0	6
07-CCH	5	2.1 - 5.7	0	5
02-MAR	1	0.5	0	1
01-MAR	1	3.0	0	1
01F-RAT	1	0.0	0	1
03-AXE	1	2.0	0	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				63

Turbidity levels were relatively low at most stations (Figure 4). There were two stations (19-CCH and 11-CCH) with single turbidity measurements that were slightly higher. Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In general it is typical to see a rise in turbidity in more developed areas due to increased runoff.

**Figure 4. Turbidity Statistics for the Cocheco River
June 20 - October 16, 2005, NHDES VRAP**



Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- ❖ Collect samples during wet weather. This will help us to understand how the river responds to runoff and sedimentation.
- ❖ If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels volunteers should contact NHDES.

4.4. Specific Conductance

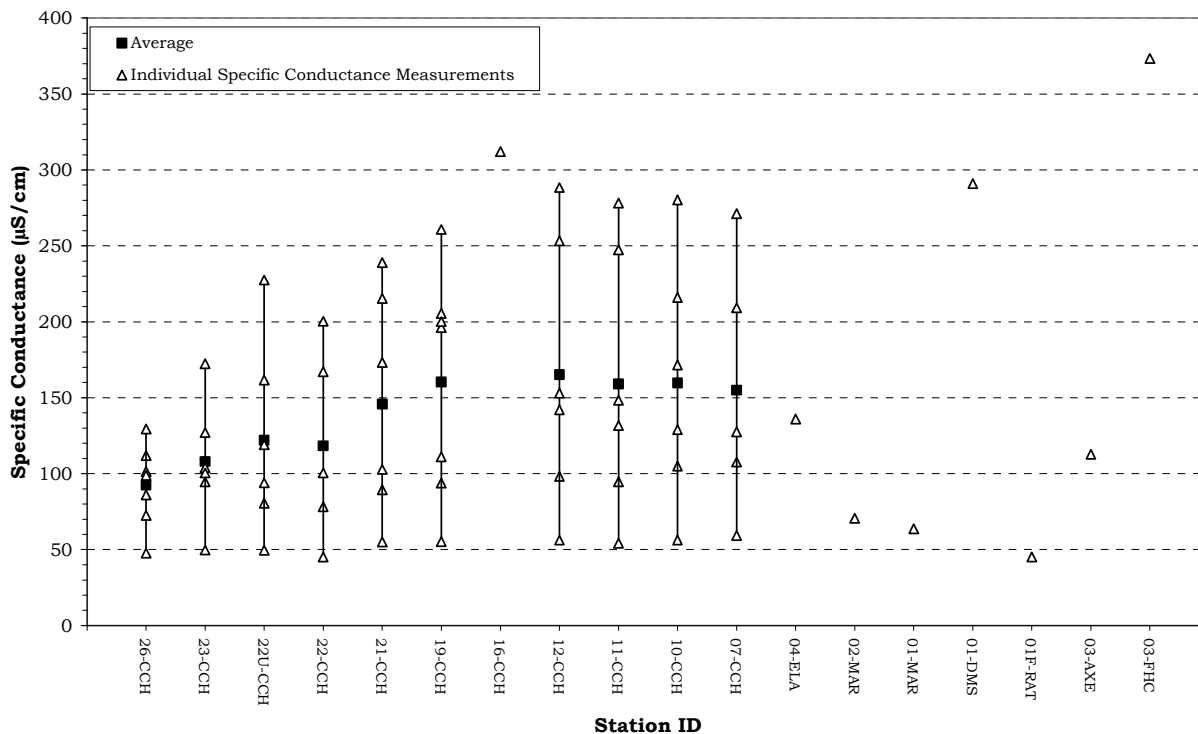
Between one and seven measurements were taken in the field for specific conductance at 18 stations on the mainstem and tributaries of the Cocheco River from Farmington to Rollinsford [Table 7]. Of the 68 measurements taken, all met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. New Hampshire surface water quality standards do not contain numeric limits for specific conductance.

Table 7. Specific Conductance Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range ($\mu\text{S}/\text{cm}$)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	7	47.7 - 129.4	Not Applicable	7
23-CCH	6	49.7 - 172.4	N/A	6
22U-CCH	6	49.6 - 227.5	N/A	6
22-CCH	5	45.2 - 200.3	N/A	5
21-CCH	6	55.1 - 239.0	N/A	6
19-CCH	7	55.2 - 260.8	N/A	7
16-CCH	1	312.1	N/A	1
12-CCH	6	56.2 - 288.4	N/A	6
11-CCH	6	54.3 - 278.1	N/A	6
10-CCH	6	56.4 - 280.3	N/A	6
07-CCH	5	59.3 - 271.2	N/A	5
04-ELA	1	136.0	N/A	1
02-MAR	1	70.7	N/A	1
01-MAR	1	63.7	N/A	1
01-DMS	1	291.0	N/A	1
01F-RAT	1	45.2	N/A	1
03-AXE	1	112.8	N/A	1
03-FHC	1	373.4	N/A	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				68

Specific conductance levels were variable along the entire reach of the river with individual readings ranging from 45 $\mu\text{S}/\text{cm}$ to 373 $\mu\text{S}/\text{cm}$ (Figure 5). Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. Thus, the variable specific conductance levels in the Cocheco River watershed indicate low pollutant levels at some stations and potentially higher levels at others.

**Figure 5. Specific Conductance Statistics for the Cocheco River
June 20 - October 16, 2005, NHDES VRAP**



Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- ❖ Consider collecting chloride samples at the same time specific conductance is measured. During the late winter/early spring snowmelt, higher conductivity levels are often seen due to elevated concentrations of chloride in the runoff. Conductivity levels are very closely correlated to chloride levels. Simultaneously measuring chloride and conductivity will allow for a better understanding of their relationship.

4.5. Bacteria/*Escherichia coli*

Between five and six measurements were taken in the field for *Escherichia coli* (*E. coli*) at ten stations on the mainstem of the Cocheco River from Farmington to Dover (Table 8). All measurements met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency. Class B NH surface water quality standards for *E.coli* are as follows:

<406 cts/100 ml, based on any single sample, or
<126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

Table 8. E. Coli Single Sample Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range (cts/100ml)	Single Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	5	60 - 150	0	5
23-CCH	5	90 - 910	1	5
22U-CCH	5	110 - 370	0	5
22-CCH	5	0 - 460	1	5
21-CCH	6	40 - 280	0	6
19-CCH	6	110 - 1890	2	6
12-CCH	6	20 - 290	0	6
11-CCH	6	0 - 400	0	6
10-CCH	5	50 - 400	0	5
07-CCH	5	20 - 310	0	5
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				54

Three of the ten stations tested for *E.coli* had single sample levels which exceeded the New Hampshire surface water quality standard (Figure 6). In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period. At all ten stations multiple geometric means were calculated and eight of the stations had geometric means that violated the surface water quality standard of 126 cts/100ml (Table 9).

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife (e.g., birds), and the presence of septic systems along the river.

**Figure 6. *Escherichia coli* Statistics for the Cocheco River
June 20 - October 17, 2005, NHDES VRAP**

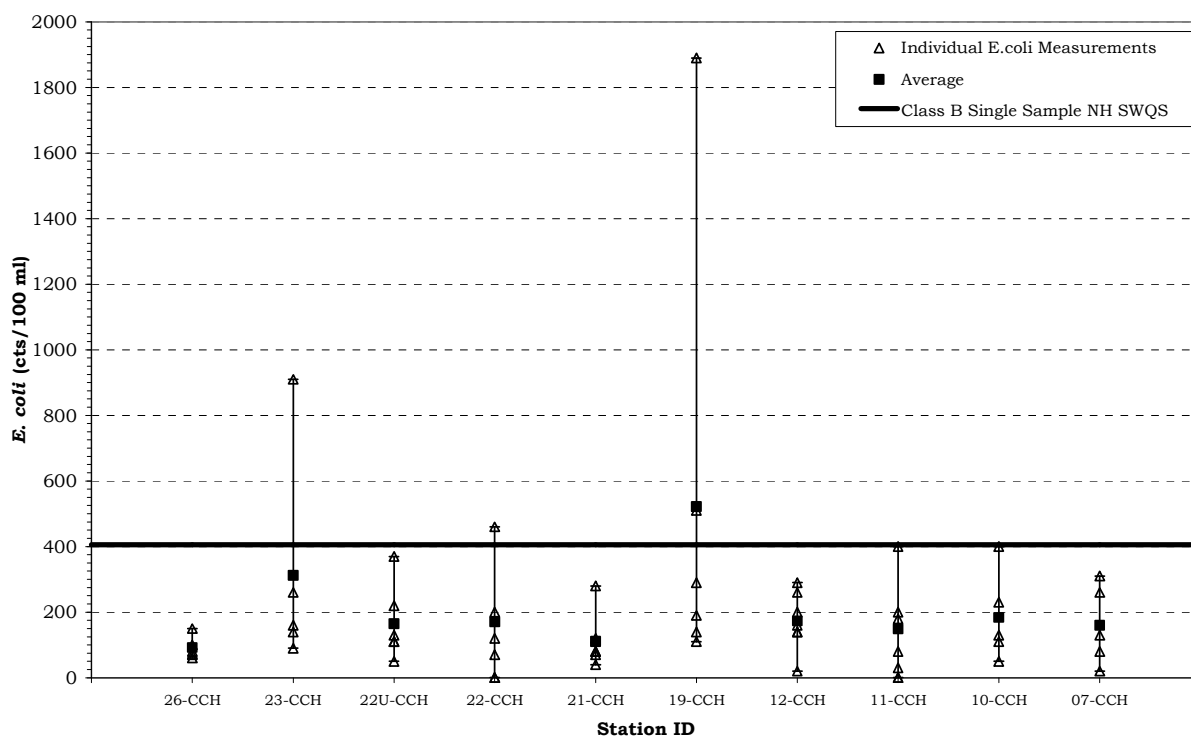


Table 9. *E. coli* Geometric Mean Data Summary - Cocheco River, 2005

Station ID	Number of Geometric Means Calculated	Geometric Means Not Meeting NH Class B Standards
26-CCH	2	0
23-CCH	2	2
22U-CCH	3	3
22-CCH	3	1
21-CCH	4	2
19-CCH	4	4
12-CCH	4	1
11-CCH	4	1
10-CCH	3	3
07-CCH	3	0

Recommendations

- ❖ Continue collecting three samples within any 60-day period during the summer to allow for determination of geometric means.
- ❖ Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).
- ❖ At stations with particularly high bacteria levels (i.e. 19-CCH), volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes and failed septic systems.

4.6. Total Phosphorus

Either one or two samples were collected for total phosphorous at 11 stations on the mainstem of the Cocheco River and its tributaries from Farmington to Dover (Table 10). All samples met quality assurance/quality control (QA/QC) requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

There is no numeric standard for total phosphorus for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses." The NHDES "level of concern" for total phosphorous is 0.05 mg/L.

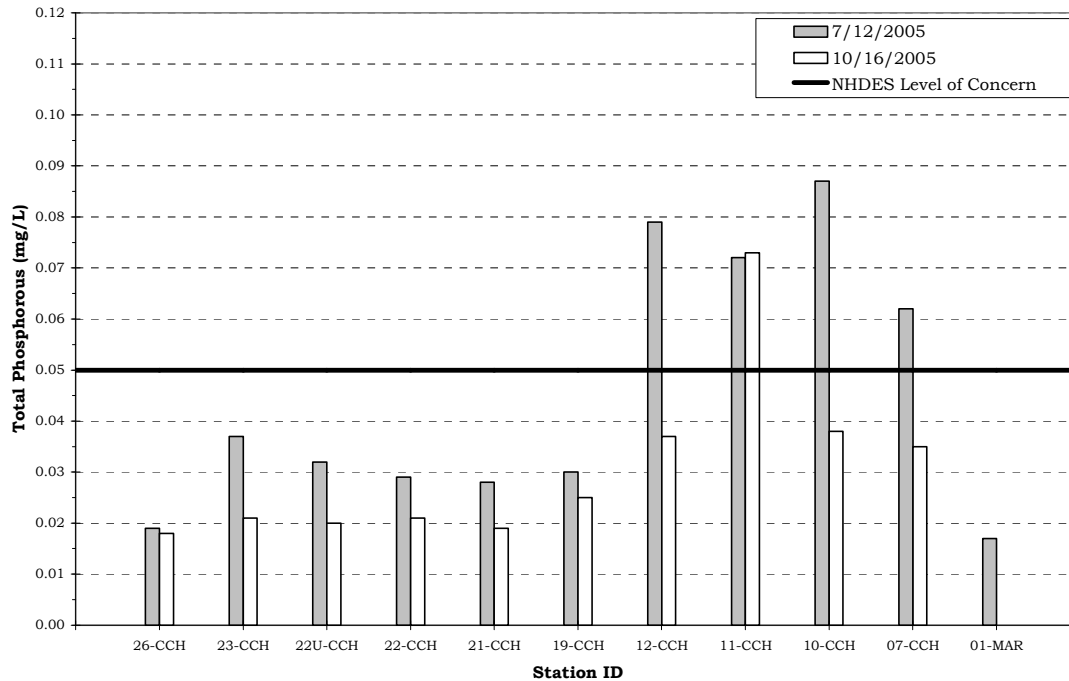
Table 10. Total Phosphorus Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Exceeding NHDES Level of Concern	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	2	0.018 - 0.019	0	2
23-CCH	2	0.021 - 0.037	0	2
22U-CCH	2	0.02 - 0.032	0	2
22-CCH	2	0.021 - 0.029	0	2
21-CCH	2	0.019 - 0.028	0	2
19-CCH	2	0.025 - 0.03	0	2
12-CCH	2	0.035 - 0.079	1	3
11-CCH	2	0.072 - 0.073	2	2
10-CCH	2	0.038 - 0.087	1	2
07-CCH	2	0.035 - 0.062	1	2
01-MAR	1	0.017	0	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				22

Total phosphorous levels were variable but, in general, levels increased from upstream stations to downstream stations. All measurements upstream of 12-CCH were below NHDES's level of concern. A majority of total phosphorous measurements at 12-CCH and the three stations further downstream exceeded NHDES's level of concern. Under undisturbed natural conditions phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorous, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity, algae respond with significant growth.

A major source of excessive phosphorous concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus.

**Figure 7. Total Phosphorous Statistics for the Cocheco River
July 12 and October 16, 2005 NHDES VRAP**



Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.

4.7. Ammonia

One sample was collected for ammonia (NH₃) at ten stations on the mainstem of the Cocheco River from Farmington to Dover (Table 11). All samples results met QA/QC requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

A numeric Class B NH surface water quality standard does exist for ammonia and is dependent on the pH and temperature (e.g for pH 6.5 the standard is <3.48 mg/L and for pH 7.0 it is <3.08 mg/L).

Table 11. Ammonia Data Summary - Cocheco River, 10/16/05

Station ID	Data Range (mg/L)	Acceptable Samples Exceeding NHDES Freshwater Chronic Criteria	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	<0.05	0	1
23-CCH	<0.05	0	1
22U-CCH	<0.05	0	1
22-CCH	<0.05	0	1
21-CCH	<0.05	0	1
19-CCH	<0.05	0	1
12-CCH	<0.05	0	1
11-CCH	<0.05	0	1
10-CCH	<0.05	0	1
07-CCH	<0.05	0	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment			10

Ammonia concentrations were below 0.05 mg/L at all stations which are well below the chronic standard. Ammonia can be a good indicator of recent pollution, such as that from agricultural runoff or problems with wastewater treatment systems. Through the process of ammonification amino acids are broken down by decomposer organisms to produce ammonia. During this process part of the ammonia is trapped in the soil and part of it is dissolved into water. Ammonia that is dissolved into water in the soil can make its way into surface waters through runoff during precipitation. This runoff will be significantly higher in more urbanized areas with a high amount of non-porous surfaces such as asphalt and pavement.

Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.

4.8. Total Kjeldahl Nitrogen (TKN)

One sample was collected for Total Kjeldahl Nitrogen (TKN) at ten stations on the mainstem of the Cocheco River from Farmington to Dover (Table 12). All samples results met QA/QC requirements and are usable for New Hampshire's 2006 surface water quality report to the Environmental Protection Agency.

There is no numeric standard for TKN for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no nitrogen in such concentrations that would impair any existing or designated uses."

Table 12. TKN Data Summary - Cocheco River, 2005

Station ID	Samples Collected	Data Range (mg/L)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2006 NH Surface Water Quality Assessment
26-CCH	1	0.4	Not Applicable	1
23-CCH	1	0.4	N/A	1
22U-CCH	1	0.4	N/A	1
22-CCH	1	1.3	N/A	1
21-CCH	1	0.4	N/A	1
19-CCH	1	0.4	N/A	1
12-CCH	1	0.5	N/A	1
11-CCH	1	0.6	N/A	1
10-CCH	1	0.5	N/A	1
07-CCH	1	0.5	N/A	1
Total Number of Useable Samples for 2006 NH Surface Water Quality Assessment				10

TKN concentrations ranged from 0.4 mg/L to 0.6 mg/L at all stations except for 22-CCH which measured 1.3 mg/L. Given the significant increase from 22U-CCH to 22-CCH there is likely a higher than normal source of nitrogen between those two stations.

TKN is unoxidized nitrogen and a measurement of the combined concentration of organic nitrogen and ammonia. Nitrogen is naturally occurring in soil in organic forms from decomposing plant and animal matter. Bacteria in the soil then convert nitrogen to nitrate, a nitrogen-oxygen chemical unit. Primary sources which can cause increased nitrate levels are human sewage, livestock manure, and agricultural fertilizers. Higher TKN values may also be indicative of high production rates, algal growth and decomposing organics.

Recommendations

- ❖ Continue sampling at all stations as this will help to build a long-term data set to better understand trends as time goes on.
- ❖ More in depth sampling is recommended for the portion of the river between 22U-CCH and 22-CCH. NHDES is available to assist in choosing additional sampling sites to help locate the source of the higher TKN levels.

APPENDIX A

2005 Cocheco River Watershed Water Quality Data

APPENDIX B

Interpreting VRAP Water Quality Parameters

APPENDIX C

Glossary of River Ecology Terms